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BACKGROUND OF THE INVENTION

The present invention relates to an arrangement for inclined rolling of tube-shaped or bar-shaped rolling products.

5 Arrangements for inclined rolling are mainly used for manufacture of seamless tubes, for example perforation of a round insert block and thereby for manufacture of relatively thick walled hollow block, or for stretching of such a hollow
10 block with a reduction of its wall thickness or for expanding a tube loop. Moreover, it is known to use such arrangements for stretching and for cross-section reduction of bar-shaped or in other words massive rolling products.

In conventional arrangements of this type the rolling product is driven in rotation in two rollers which
15 rotate in the same rotary direction and thereby is deformed. For obtaining a controllable displacement of the rolling product in the longitudinal direction the roller axes are arranged relative to the longitudinal axis of the rolling product with a pivoting angle. Therefore, from the peripheral
20 speed of the rollers, a component in the longitudinal direction of the rolling product is produced and the rolling product is moved in a helical movement between the rollers in the longitudinal direction. Such arrangements have two or more driven rollers. Lateral guides between the rollers are
25 needed when only two rollers are provided so that the rolling

1 product remains in the region of the rolling axis does not
spring out in a radial direction.

In such arrangements the barrel-shaped rollers are
utilized with the roller axes extending parallel to the
5 longitudinal axis of the rolling product. Moreover, it is
known to use conical rollers in which the roller axes are
inclined to the longitudinal axis of the rolling product. The
inclination angle which is obtained here between the roller
axes and the longitudinal axis of the rolling product should
10 not be confused with the above mentioned pivoting angle, since
the inclination angle alone without turning of the roller axes
cannot provide an axial feed of the rolling product.

In the above mentioned arrangement the rolling
product rotates about its longitudinal axis, which causes
15 several problems. First of all rolling products of limited
length only can be rolled, in order to avoid its unsteady
rotary movement and to prevent damages to the rolling product
and to the arrangement. Secondly, expensive guiding devices
for the rolling product and for eventually available inner
20 tools are needed. Thirdly, the rolling product throughput and
thereby the efficiency of the arrangement is narrowly limited.
The rolling product throughput is determined by the feeding
speed, and it is produced from the peripheral speed of the
rolling product and the magnitude of the pivoting angle.
25 Since the pivoting angle cannot exceed a predetermined

1 magnitude because otherwise the surface of the rolling product
becomes non-uniform and in particular wavy, the rolling
product throughput is increased only by an increase in the
peripheral speed. However, this increases the rotary speed of
5 the rolling product as well which leads to an unsteady running
resulting in damages to the rolling product, disturbances in
the machinery and increased wear. Moreover, the rolling
product during rolling must be accelerated stronger in view of
the higher rotary speed of the rolling, which leads to sliding
10 of the rollers and thereby to gripping problems. Fourthly,
the rolling product which rotates about its longitudinal axis
prevents a continuous finishing rolling in longitudinal
rolling stands arranged at a short distance.

15 In view of the above disadvantages the kinematic
principle of the inclined rolling was reversed. In particular
it has been changed so that the rollers rotate not only around
their roller axes, but also around the longitudinal axis of
the rolling product. As a result the rolling product must not
be brought to rotation about its longitudinal axis. The
20 rollers roll in a planetary movement on and around the rolling
product.

Such an arrangement is disclosed for example in U.S.
Patent 1,368,413. Here the rollers are supported with their
roller shafts in a rotary housing which is driven through a
25 toothed rim and a pinion. The shafts which drive the rollers

1 has ends which face away from the rollers and are provided
with toothed gears rolling on a sun gear as in a planetary
transmission. The sun gear is also driven. With a
corresponding determination of the rotary speeds of the
5 rollers and the rotatable housing it is possible to roll the
rollers on the rolling product without driving it in rotation.
The rollers of this known type are barrel shaped and their
roller axes extend in planes which are parallel to the
longitudinal axis of the rolling product. The roller axes
10 however are turned by an angle relative to the longitudinal
axis of the rolling product in these planes, and thereby the
feeding movement of the rolling product is produced. Also,
the axes of the planetary gears extend with this angle
relative to the longitudinal axis of the rolling product, but
15 they are located in a plane which includes the longitudinal
axis of the rolling product. The roller drive shafts between
the planetary gears and the rollers are provided at their ends
with joint couplings. In order to maintain the bending angle
of the joint couplings not too great, the roller drive shafts
20 are relatively long. This however leads to a long
construction of the rotatable housing. Moreover, the long
roller drive shafts are subjected during rotation of the
rotatable housing to centrifugal forces and gyroscopic
moments, which limits the rotary speed of the housing.

25 The German document DE-OS 16 02 153 shows in Fig. 1

1 an arrangement which in principle has the above described
features. Fig. 2 however illustrates another construction.
Here the rollers are conical and the roller axes extend under
an inclination angle relative to the longitudinal axis of the
5 rolling product. The rollers are supported floatingly in
heads which are arranged at the end side of a rotor housing
rotating around the longitudinal axis of the rolling product
and driven through a toothed rim. The rollers are driven
through several toothed gears or toothed gear drive steps
10 arranged radially from the longitudinal axis of the rolling
product one after the other. The first toothed gear engages
a sun gear and rolls on it by the rotary movement of the rotor
housing in which it is supported. In U.S. Patent 1,368,413
the sun gear in this known construction is rotated by a
15 special drive. The rotary speed of the sun gear and the
rotary speed of the rotor housing can be selected so that the
rollers roll on the rolling product without driving it in
rotation. With the above mentioned inclination of the roller
axes relative to the longitudinal axis of the rolling product
20 no rolling product feed can be obtained. The feed is produced
by a pivoting of the head which is arranged turnably around a
bevel gear axis on the rotor housing. The pivoting angle
produced in this manner is not shown in Fig. 2 of this
reference. This construction has three rollers and is
25 provided both for tube-shaped and for bar-shaped rolling

1 products.

5 The latter construction is very expensive because of its roller drive. The toothed gears of the roller drive staggered radially outwardly from the longitudinal axis of the rolling product operates so that the rotating rotor housing has a huge outer diameter which, depending on the cross-sectional size of the rolling product, amounts to approximately 3 - 5 meter. The rollers, the roller shaft, their bearings and the head which has the drive gears are arranged on this big rotor housing, so that extraordinarily high rotating masses are produced in the case of great outer diameters. Because of the thusly generated centrifugal forces, the rotary speed of the rotor housing with the head is very limited and therefore the feeding speed of the rolling product is also limited. As a result, the throughput of the rolling product per time unit and therefore the efficiency is low. Since the head as well as the rotor housing have great sizes and there is a relatively great distance of the pivoting axis of the head from the corresponding roller axes, an exact adjustment and maintenance of the roller position is difficult, and different springing of the rollers under load must be taken into consideration. Because the radially outwardly staggered gear teeth is the bevel gear drive of the rollers located far outside and therefor it requires a very steep inclination of the roller axes relative to the

1 longitudinal axis of the rolling product, in order that the
axial length of the arrangement as well as the rotor housing
and the heads become greater. An inclination of the roller
axes relative to the longitudinal axis of the rolling product
5 is generally advantageous. However, when this inclination is
too steep rollers are produced with specially pronounced or in
other words flat conical shape with a strong reduction of the
roller diameter, especially in the region of the roller tip.
The smoothing zone and the rounding zone of the rollers is
10 located where the strong diameter reduction acts in a
specially negative way, causing undesired twisting of the
rolling product during rolling. This danger is caused in the
known construction by the necessary steep inclination of the
roller axes and thereby required flat conical shape of the
15 rollers.

SUMMARY OF THE INVENTION

Accordingly, it is an object of the present invention to provide an arrangement for inclined rolling of tube-shaped and bar-shaped rolling products, with two or more driven rollers which are rotatable about the longitudinal axis of the rolling product and have roller axes extending inclinedly under an inclination angle relative to the longitudinal axis of the rolling product.

It is an object of the present invention to provide an arrangement of this type which avoids the disadvantages of the prior art and has smaller dimensions with increased efficiency.

In keeping with these objects and with others which will become apparent hereinafter, one feature of the present invention resides, briefly stated, in an arrangement of the above mentioned type in which for producing a rolling product feed the roller axes are inclined in such planes which extend, when considered in or opposite to the longitudinal axis of the rolling product, with a radial distance parallel near the longitudinal axis of the rolling product, and the rollers are driven by a sun wheel through a drive gear which has an axis-offset bevel gear toothing, engages with the sun gear and surrounds the corresponding roller axes.

In the arrangement in accordance with the present invention, the rolling product feed can be produced not only

1 as in the known constructions with a turning of the rollers
and the roller axes under a pivoting angle relative to the
longitudinal axis of the rolling product, but such a turning
can be dispensed when the roller axes extend correspondingly
5 within a plane arranged at a radial distance from and parallel
to the longitudinal axis of the rolling product as considered
in or opposite to the longitudinal axis of the rolling
product. This new arrangement of the roller axes produces
however the desired rolling product feed only when the roller
10 axes are inclined within the above mentioned planes under an
inclination angle relative to the longitudinal axis of the
rolling product, or in other words the rollers are formed
substantially cone-shaped or truncated cone-shaped. When the
rollers are barrel-shaped or cylindrical and their roller axes
15 have no inclination angle, no rolling product feed is produced
without the pivoting angle. When substantially conical
rollers and thereby roller axes are utilized instead and they
are inclined under an inclination angle relative to the
longitudinal axis of the rolling product, the additional
20 utilization of a pivoting angle can be dispensed with as
available in the above mentioned constructions with driving of
the rolling product in the longitudinal direction.

In the inventive arrangement, when considered in or
against the longitudinal axis of the rolling product, the
25 laterally offset, parallel arrangement of the roller axes

1 relative to the longitudinal axis of the rolling product with
an inclination angle which is not seen with this view, a
substantially compact construction of the arrangement is
provided. The reason is that it is possible to arrange each
5 roller axes or roller shaft in association with a drive gear
for the rollers, which engages directly with the sun gear and
thereby rolls on it. Therefore, all joint shafts and joint
couplings or toothed gears located between the sun gear and
the roller shafts are dispensed with. With the laterally
10 parallel offset of the roller axes in the construction having
the drive gears and the sun gear it is however necessary to
use an axis-offset bevel gear toothing which is known from
other solutions. Since in such construction numerous parts
are eliminated, the masses rotating about the longitudinal
15 axis of the rolling product are reduced, the distance between
the remaining parts from the longitudinal axis of the rolling
product is small, and the centrifugal forces are substantially
reduced. Therefore the arrangement can be not only
substantially smaller for the same cross-section of the
20 rolling product, but also the rotation can be performed with
substantially higher rotary speed about the longitudinal axis
of the rolling product and as a result a higher throughput of
the rolling product or in other words a substantially improved
efficiency is obtained. In the inventive solution the
25 inclination angle between the roller axes and the longitudinal

1 axis of the rolling product is also relatively small. This
not only makes the drive gears and therefore the whole
arrangement small, but also leads to a less pronounced conical
shape of the rollers or in other words to a more cylindrical
5 roller shape. With this roller shape the roller diameter
decreases less, especially in the region of the smoothing zone
and the rounding zone. Therefore the twisting of the rolling
product is avoided, which otherwise easily occurs especially
in the case of rolling thin walled tubes in this region.

10 In accordance with an advantageous embodiment of the
present invention, the drive gears engaging with the sun gear
are arranged fixedly and directly on the shafts which carry
the rollers. In this construction an adjustment of the radial
distance of the roller or the roller axes from the
15 longitudinal axis of the rolling product is not possible, so
that feed of the rolling product remains the same. When in
this embodiment the drive gears are also arranged non-
displaceably in the axial direction on the shaft carrying the
rollers, then in view of the fact that it is necessary to
20 maintain the engagement of the toothed gears, also an axial
displacement of the shafts which carry the rollers and also
the axial displacement of the rollers is not possible. When
differently thick inserts are arranged between the rollers and
the shaft which carry the rollers, then in this embodiment the
25 rollers can be adjusted in the axial direction and therefore

1 in view of their inclination relative to the axis of the
roller product the diameter of the rolling product can be also
adjusted. During rolling of tubes, the wall thickness of the
rolling product can be adjusted by corresponding selection of
5 the diameter of the inwardly located tool to the desired size.
It is generally faster and more accurate than a roller
adjustment and avoids an undesirable change of the cylindrical
smoothing caliber shape. Moreover, in this simple embodiment
an especially compact arrangement with a high stability
10 against the occurring roller forces is provided.

It is also possible to form the drive gears which
engage with the sun gears so that in their hub region a hollow
toothing is arranged, and an outer toothing of a shaft which
carries a respective roller engages in the hollow toothing.
15 The shaft can be supported in a rotatable eccentric bushing
and adjustable transversely to the drive gear and to the
longitudinal axis of the rolling product. In this arrangement
the radial distance of the roller axes from the longitudinal
axis of the rolling product can be adjusted and thereby the
20 feed of the rolling product can be changed.

In accordance with a further advantageous embodiment
of the invention, the rollers are adjustable in direction of
their roller axes. This can be provided first of all by an
axially displaceable and preferably steplessly adjustable
25 support of the shafts which carry the rollers. In this manner

1 the smallest diameter described jointly by all rollers can be
changed, and thereby the finishing diameter of the rolling
product can be changed as well. The adjustability of the
shafts and the rollers in the longitudinal direction of the
5 roller axes can be also combined with the previously mentioned
transverse adjustment of the roller axes, so that in such an
arrangement both the outer diameter of the rolling product and
the feed of the rolling product can be changed. On the other
hand, an adjustment of the rollers in direction of their
10 roller axes can be performed in the above described manner by
inserts. The produced rollers can be brought to a desired
position by the use of other inserts, so as to obtain a high
accuracy and reproducibility of the caliber adjustment.

15 The above described constructions and approaches to
the axial and radial adjustment of the rollers and their
roller shafts can be also utilized for other structural
solutions.

20 In accordance with an especially advantageous
embodiment of the invention, all four driven rollers are
provided. The use of four instead of frequently utilized
three rollers has the advantage that the cross-section of the
rolling product can be enclosed narrower by the rollers. This
leads especially during rolling of thin walled tubes, to a
smaller expansion of the rolling product between the rollers
25 and thereby to a reduction of additional bending loads and

1 sliding of the workpiece. Moreover, with the four rollers,
the roller diameter which leads to the maximum possible
embracing of the rolling product is smaller than in the case
of three rollers. Smaller roller diameters provide for a
5 substantial advantage of smaller rolling moments. Therefore,
all parts of the roller drive and the rotor can be smaller and
lighter and the arrangement as a whole can be more compact.
The use of the rollers with the smaller diameter in which the
reduction of the roller diameter in the region of the
10 smoothing zone and the rounding zone therefore the problem of
the rolling product sliding is grave, is not problematic in
the inventive arrangement since it utilizes an especially flat
inclination angle which acts in a compensating manner.

The novel features which are considered as
15 characteristic for the invention are set forth in particular
in the appended claims. The invention itself, however, both
as to its construction and its method of operation, together
with additional objects and advantages thereof, will be best
understood from the following description of specific
20 embodiments when read in connection with the accompanying
drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGS. 1 - 3 are views showing an arrangement for inclined rolling of tube-shaped and bar-shaped rolling products correspondingly on a front view, a side view and a plan view;

FIG. 4 is a view showing the inventive arrangement without a roller adjustment in a schematic illustration;

FIG. 5 is a view showing the inventive arrangement with an axial roller adjustment; and

FIG. 6 is a view showing the inventive arrangement with an axial and radial roller adjustment.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The cross-sectional surfaces of a rolling product is identified with reference numeral 1 on a front view of FIG. 1. It is formed as a massive bar. The rolling product can however be also formed as a tube or a tube loop, and an inner tool such as for example a mandrel rod can be located in it. The rolling product 1 is formed by several rollers 2 which surround the rolling product 1. In FIGS. 1 - 3 only one roller 2 is shown for the clarify of illustration of the inventive features. The rollers 2 gyrate in a planetary fashion around an axis 3 of the rolling product extending perpendicular to the plane of the drawing in FIG. 1. The rollers 2 rotate their roller axes 4 and roll on an outer surface of the rolling product 1. The rollers 2 in the shown example are substantially conical. They have the shape of two frusto-cones arranged over one another and having differently inclined peripheral surfaces. It is especially clearly shown on the side view of FIG. 2, in which it can be seen that the roller axes 4 extend under an inclination angle relative to the longitudinal axis 3 of the rolling product. This known inclination angle does not cause any axial feed of the rolling product 1 when the roller axes 4 and longitudinal axis 3 of the rolling product are located in one plane. The additionally utilized pivoting angle which is provided in the known constructions is not provided in the inventive arrangement, as

1 can be seen in particular in FIG. 1. On the front view of
this Figure when seen in or against the longitudinal axis 3 of
the rolling product, it can be seen that the plane in which
the roller axes 4 extend inclinedly is located parallel to the
5 longitudinal axis 3 of the rolling product at a radial
distance E from it. From the configuration of a contact point
5 between the roller 2 and the rolling product 1, it can be
seen that the roller peripheral speed 6 produces a component
7 in the feeding direction of the rolling product 1. Also,
10 from the plan view of FIG. 3 the component 7 which causes the
feed can be recognized as well.

FIG. 4 shows an arrangement partially in a
longitudinal section in which the rollers 2 and their roller
axes 4 are arranged in the inventive manner. Two rollers 2
15 are visible on these drawings while two further rollers 2,
forming together for example four rollers, are located in a
foreground and in a background and therefore not shown for
more clear illustration of the other two rollers 2.

The rollers 2 are driven by a motor. The drive is
20 performed through shafts 8 which carry the rollers. Drive
gears 9 are arranged directly on the shafts 8 and fixedly
connected with them for joint rotation. The drive gears 9
engage with a sun gear 10 which surrounds the rolling product
1. For this purpose, an axis-offset bevel gear toothing 11 is
25 used by reason of the distance E in FIG. 1. The sun gear 10

1 has a longitudinally extending drive bushing 12 which fixedly
connects the sun gear 10 with a toothed gear 13 for joint
rotation, and the toothed gear 13 is controllably driven
through a pinion 49 from the not shown motor. The shafts 8
5 which carry the rollers 2 are rotatably supported in a rotor
14 which in turn rotates around the longitudinal axis 3 of the
rolling product, since it is rotatably supported in a housing
15. The rotor 14 is driven by a further pinion 16 which
engages in a toothed rim 17 of the rotor 14 and is also
10 separably driven by a not shown motor.

FIG. 5 shows a support for only one roller 2 on an
enlarged scale, while the arrangement is formed substantially
as shown in FIG. 4. Same or similar parts are identified here
with the same reference numerals. The construction of FIG. 5
15 makes possible through an axial adjustment of the rollers 2 by
adjusting the shafts 8, while the construction of FIG. 4 makes
possible an axial adjustment of the rollers 2 only by
differently thick inserts between the rollers 2 and the shafts
8. The rollers 2 are tensioned each by a pulling anchor 18 in
20 an axial direction fixedly with its shaft 8, which pulling
anchor is arranged in a central longitudinal opening of the
shaft 8. Radial bearings 19 and 20 provide a limited but
sufficient axial displacement of the shaft 8. The drive gear
9 is screwed in this construction with a bearing bushing 21
25 which is supported through an axial bearing 22 and the radial

1 bearing 23 rotatably and axially non-displaceably in the rotor
14. The rotor, in turn, is supported through a bearing 24 in
the housing 15. The rotor 14 has bushings 25 and 26 which
surround both the shaft 8 as well as the bearing bushing 21
5 which surrounds the same. The bushings 25 and 26 are screwed
with a rotor 14 and rotate with it around the longitudinal
axis 3 of the rolling product. In other aspects, the bushings
25 and 26 are stationary. The same is true for the drive gear
9 and the bearing bushing 21. The shaft 8 and also the roller
10 2 as well as the pulling anchor 18 perform the rotary movement
around the longitudinal axis 3 of the rolling product.
However, with these parts a displaceable relative to the
remaining parts in particular relative to the bushings 25 and
26 in or against the direction of the roller axes 4. The
15 rotary fixed coupling between the bearing bushings 21 and the
shaft 8 with the roller 2 is produced through a coupling
bushing 27, which engages in a toothing 28 of the bearing
bushing 21 and also in a toothing 29 of the shaft 8. The
toothings 28 and 29 allow a relative displacement in the
20 longitudinal direction. FIG. 5 shows this situation during
the rolling operation, in which the drive rotary movement is
transmitted from the drive gear 9 through the bearing bushing
21, the coupling bushing 27 and the shaft 8 to the roller 2.

When during adjustment of the arrangement the roller
25 2 must be displaced in the axial direction, the rotor 14 is

1 turned to an adjusting position. A working cylinder 30
displaces by its bushing 31 a plate 32 against the action of
a pressure spring 33 in an axial direction, so that the
pressure pin 34 engages in a third toothing 35 of the coupling
5 bushing 27 and couples it fixedly with the rotor 14. The
pressure pin 34 presses the coupling bushing 27 further toward
the roller 2 until the toothing 28 of the bearing bushing 21
is no longer in engagement with the coupling bushing 27, which
is maintained however for the longer toothing 29 of the shaft
10 8. When the sun gear 10 is slowly rotated by a separate
drive, then with the stationary rotor drive only the drive
gear 9 with the bearing bushing 21 is rotated. A thread 36
between the shaft 8 and the bearing bushing 21 operates so
that the shaft 8 is displaced in direction of the roller axis
15 4 with it the roller 2 is displaced as well. When its
position is adjusted and the sun gear 10 is stopped, the
working cylinder 30 is relieved from the pressure medium
pressure and the plate 32 is released. The pressure spring 33
displaces the pressure pin 34 and a further pressure spring 37
20 displaces the coupling bushing 27 again to the operating
position. In this position the toothing 28 is engaged and the
shaft 8 as well as the roller 2 is driven again. The above
described operation is true for each roller 2 and its support.

FIG. 6 shows a substantially different construction
25 of the arrangement. The parts which are identical or similar

1 are identified with the same reference numerals as in FIG. 5,
also, when the construction of these parts is somewhat
different. For example the tothing 28 of the bearing bushing
21 in FIG. 6 is substantially longer than the tothing 29 of
5 the shaft 8. The tothing 29 is as long as the engaging
tothing on the coupling sleeve 27. When it is moved by the
working cylinder 30 in direction of the roller 2, tothing 29
disengages faster in view of the shortened length. Then the
shaft 8 and the roller 2 with it is rotatable by the sun gear
10 and the drive gear 9 relative to the fixedly held bearing
bushing 21 and is displaceable because of the thread 36 in the
axial direction. The bearing bushing 21 is held non-rotatably
by the non-rotatably arranged and formed working cylinder 30
through its bushing 31, a tothing 45, the plate 32, the
15 coupling bushing 27 screwed with it, and the tothing 28.

In the construction of FIG. 6 the other differences
include the fact that the shaft 8 and the roller 2 with it is
adjustable transversely to the longitudinal axis 3 of the
rolling product. The drive gear 9 is rotatably supported in
20 a connecting member 44 of the rotor 14 with a fixed bearing 38
and a movable bearing 39 and remains therefore in a correct
engagement with the sun gear 10. The drive gear 9 is provided
in the hub region with a hollow tothing 40 in which an outer
tothing 41 engages. This is however only on a limited part
25 of the periphery as identified with 42, since the outer

1 toothing 41 of the shaft 8 has a substantially smaller
diameter than the hollow toothing 40. The adjustment path of
the shaft 8 is produced in this way. The shaft is supported
in an eccentric bushing 43 which is rotatable and fixable in
5 the rotor 14, and the bushing 25 in FIG. 6 is formed as such
an eccentric bush. A timing of the eccentric bushings 25 and
43 in which the radial bearings 23 and 20 are located leads to
a transverse displacement of the shaft 8 and the roller 2.
The turning of both eccentric bushings is performed
10 synchronously by the connecting member 44 coupled to them,
after the screws 46 are loosened.

In the examples which are described above and shown
in the drawings, the throughgoing direction of the rolling
product is selected so that a converging arrangement of the
15 rollers is provided. It is also however possible to change
the throughgoing direction of the rolling product so that the
roller arrangement is diverging. The latter is produced when
the arrangement is utilized for example as an expanding roller
stand for tubes.

20 It will be understood that each of the elements
described above, or two or more together, may also find a
useful application in other types of constructions differing
from the types described above.

While the invention has been illustrated and
25 described as embodied in an arrangement for inclined rolling

1 of tube-shaped or bar-shaped rolling products, it is not
intended to be limited to the details shown, since various
modifications and structural changes may be made without
departing in any way from the spirit of the present invention.

5 Without further analysis, the foregoing will so
fully reveal the gist of the present invention that others
can, by applying current knowledge, readily adapt it for
various applications without omitting features that, from the
standpoint of prior art, fairly constitute essential
10 characteristics of the generic or specific aspects of this
invention.

What is claimed as new and desired to be protected
by Letters Patent is set forth in the appended claims.